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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Applicant: Roger R. Lesieur et al
Serial No.: 10/091,223
Filed: March 5, 2002
For: "Autothermal Fuel Gas Reformer Assemblage"

Docket No.: C-2351DIV
Group: 1764
Examiner: A. Doroshenk

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

Enclosed are three copies of a combined Notice of Appeal and Appeal Brief for use in connection with the captioned patent application. Please charge the applicable fee of $660.00 due in connection with this matter to Special Account No. 50-1307. Order No. C-2351A. A duplicate copy of this letter is enclosed.

Respectfully submitted,

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Date: 1-23-04

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed to the Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450, on

1-24-04

Signature

1-24-04

Date

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COMBINED NOTICE OF APPEAL AND APPEAL BRIEF UNDER RULE 192

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Dear Sir:

This is a combined notice of appeal and appeal brief appealing from the decision of the Examiner dated December 10, 2003 rejecting claims 3-17 in the above-identified application. These claims have been twice rejected without having been amended.

(1) REAL PARTIES IN INTEREST:

International Fuel Cells, LLC, (now UTC Fuel Cells, LLC, by change of name) South Windsor, CT

(2) RELATED APPEALS AND INTERFERENCES:

None.

(3) STATUS OF CLAIMS:

Claims 1-17 were originally submitted for examination. Claims 1 and 2 have been canceled without prejudice and Claims 3-17 have been prosecuted. Claims 3-17 have not been amended. The second rejection of claims 3-17 is appealed herein.

(4) STATUS OF AMENDMENTS:

All amendments to the specification have been entered.

(5) SUMMARY OF THE INVENTION:

This invention (Claims 3-17) relates to a method for mixing a fuel/steam gas with an oxidant gas to form an essentially homogeneous fuel/steam/oxidant mixture which is suitable for use in an autothermal fuel gas reformer. One of the gas streams flows axially through cylindrical transfer tubes toward an inlet end of a catalyst bed in the reformer. The transfer

tubes extend through a manifold and have radial openings which provide radial flow paths from the manifold to the interior of the transfer tubes. The openings are spaced apart from the inlet end of the catalyst bed a distance which is at least two times the diameter of the transfer tubes. The other of the gas streams flows into the transfer tubes through the radial openings. A pressure differential is maintained between the manifold and the interior of the transfer tubes which ensures that the gas stream flowing radially into the transfer tubes from the manifold will be deflected into the axially flowing gas stream when the radially flowing stream penetrates the interior of the transfer tubes a distance which is about one half of the radius of the interior of the transfer tubes. This deflection of the radially flowing gas stream is the result which is sought by the method of this invention.

(6) ISSUES:

A. Is the subject matter of Claims 3, 4, 8, 12, 13 and 17 rendered obvious by Dunster et al?

B. Is the subject matter of Claims 5-7, 9-11 and 14-16 rendered obvious by the combination of Dunster et al and Fourie et al or O'Connell et al, or Lomax et al?

(7) PATENTABILITY GROUPING OF CLAIMS:

The patentability of Claims 3-17 stand or fall together.

The References Relied Upon

U.S. Pat. No. 4,865,820 Dunster et al;
U.S. Statutory Invention Registration No. H1,849 Fourie et al;
U.S. Pat. No. 6,223,843 O' Connell et al; and
U.S. Pat. No. 6,368,735 Lomax et al.

A Brief Description Of The References

Dunster et al

The Dunster et al reference discloses a gas mixer and distributor for a reactor which may be an autothermal reformer (see Col. 3, line 55). The mixer includes an inlet chamber 68 into which a gas stream P2 (66) flows at a pressure of 400 PSIA and a velocity of 100 ft/sec.. The inlet chamber 68 opens into a plurality of tubes 80. The tubes 80 each include a plurality of radial openings 86 (see FIG. 2) and open into a catalyst bed 32. The gas mixer also includes a manifold 72 into which another gas stream P1 flows at a pressure of 430 PSIA and a velocity of 110 ft./sec.. The intended result of the Dunster et al system is to create a turbulent gas flow stream in the tubes 80. We note that the terms "turbulent" or "turbulence" occurs six times in the Dunster et al specification; and again in each of the independent claims in Dunster et al. The manner in which the turbulent gas flow result is

achieved in Dunster et al is by varying the minimum gas flow velocity in the tubes 80 (see Col. 5, first full paragraph of Dunster et al). Dunster et al produces uniform gas distribution over the inlet to the catalyst bed by reducing the velocity of the gas flow into the catalyst bed by providing diverging passageways 84 at the bottom of the tubes 80 (see the second full paragraph in Col. 5 of the Dunster et al patent, and FIGS. 5 and 7 of the Dunster et al patent).

Fourie et al, O'Connell et al, and Lomax et al

The Examiner is relying on these three references for the same teaching, and that is that gasoline, diesel fuel and methanol are all reformable fuels. Applicants do not dispute that fact. Thus we will not bother to provide a brief description of these three references, which are essentially equivalent to each other as far as the disclosure of reformabel fuels goes.

The Rejections

35 USC §103

Claims 3, 4, 8, 12, 13 and 17 stand rejected as being obvious in view of Dunster et al. The Examiner in the most recent office action relies on the grounds for this rejection that were put forth in a previous office action dated June 23, 2003, which we will quote herein: "With respect to Claims 3, 8 and 13, Dunster et al discloses a method for mixing a fuel/steam or vaporized fuel with an oxidant gas or oxidant/steam gas +++ suitable for use in an autothermal fuel gas reformer catalyst bed +++ taking place in an apparatus comprising: a catalyst bed (32) having an inlet end (fig. 5); a mixing station (30) adjacent to said inlet end of the catalyst bed (fig. 5), said mixing station including an inlet chamber (68), a manifold (72) interposed between said inlet chamber (68) and said catalyst bed (32) inlet end +++; and a plurality of cylindrical transfer tubes (80) extending through said manifold (72) from said inlet chamber (68) to said inlet end of said catalyst bed +++ each of said tubes having a plurality of gas entry passages (86) in sides (sic, "side") walls of the tubes, each gas passage having an axis which is perpendicular +++ to an axis of the tubes, each passage spaced apart from the catlyst bed inlet end at a distance which is at least two times the diameter of said tubes (see fig. 2). The method comprising the steps of: providing a first gas inlet passage (66) opening into the inlet chamber (68); providing a second gas inlet passage (70) opening into said manifold (72); introducing a vaporized fuel/steam mixture)col. 3, lines 35-40) into said inlet chamber (68) or manifold (72); introducing an oxidant gas into the other of said inlet chamber (68) or said manifold (72); causing one of said fuel/steam mixture or said oxidant stream to flow axially through said transfer tubes toward the inlet of said catalyst bed and causing the other of said fuel/steam mixture or said oxidant stream to flow from said manifold (72) radially into said transfer tubes (80) through said gas entry passages (86) (col. 6, lines 9-13); maintaining a pressure differential between the interior of the transfer tubes and the manifold which will result in the radially flowing stream entering said

tubes to be entrained and deflected into the axially flowing stream (col. 5, lines 10-16).

Dunster et al does not disclose wherein the pressure differential is such that radially flowing stream penetrates the interior of the transfer tubes at a distance which is about one half of the radius of the interior of the transfer tubes, but Dunster et al does disclose wherein the pressure differential is a result-effectvie variable which effects (sic, 'affects'?) the uniformity of the gas flow (col. 5, lines 10-21). Since the pressure differential is a known result-effective variable, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify this variable to get optimum operation.

A result effective variable is a variable recognized in the art as a variable which, when modified, achieves a recognized result (MPEP 2144.05). A person having ordinary skill in the art would have found it obvious to determine the optimum value of any recognized result effective variable, as it has been held that if the difference between the claimed invention and the prior art involves the discovery of an optimum value of a result effective variable, such a discovery is ordinarily within the skill level of the art. In re Boesch and Slaney, +++ [205 USPQ 215] (CCPA 1980).

With respect to claim 4, Dunster et al does not disclose a percentage of pressure differential, Dunster et al does disclose wherein the pressure differential is a result-effective variable which effects (sic 'affects'?) the uniformity of gas flow (col. 5, lines 10-21). Since the pressure differential is a known result-effective variable, it would have been +++ to modify this variable to get optimum operation.

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With respect to claims 12 and 17, Dunster et al discloses wherein said fuel or fuel/steam mixture passes axially through said transfer tubes and said oxidant or oxidant/steam mixture enters said transfer tubes (80) from said manifold (72) (col. 7, lines 6-17).".

The aforesaid is a quotation of the grounds for rejecting Claims 3, 4, 8, 12, 13 and 17 put forth on pages 2-5 in the office action dated June 23, 2003, and reiterated in the office action dated December 10, 2003.

Claims 5-7, 9-11 and 14-16 were rejected in the office action dated December 10, 2003. These claims were rejected as being obvious over the combination of Dunster et al and any one of Fourie et al, O'Connell et al or Lomax et al. Since the three secondary references are redundant references, the rejection based on only one combination of them will be quoted below. This

"Dunster et al discloses the general reforming of hydrocarbons but does not disclose specific hydrocarbons such as gasoline, diesel fuel and methanol.

Fourie et al discloses wherein gasoline, diesel fuel and methanol are typical reformable fuels (col. 1, lines 23-29). It would have been obvious +++ to select any hydrocarbon recognized for reforming processes in the method of Fourie et al as it is merely the selection of a specific hydrocarbon known to be effective in a reforming process.".

This same reasoning has been presented in support of the Dunster et al - O'Connell et al combination, and the Dunster et al - Lomax et al combination.

(8) THE ARGUMENT

As noted above, all of the rejections of the claims in this application are based on Dunster et al, and are grounded on a "result effective variable" argument that the Examiner thinks is supported by the portions of Dunster et al which she explicitly cites. The Examiner has admitted that the result sought by the claimed subject matter in the instant application, i.e., that the radially flowing stream will be deflected so as to flow axially in the mixing tubes after a mixing tube penetration which is about half the radius of the mixing tubes <u>is not</u> a "result" that is suggested as being desirable in Dunster et al.

The Examiner argues that Dunster et al discloses wherein the pressure differential between the manifold and the tubes is a result effective variable which affects the uniformity of the gas flow in the tubes. She cites Col. 5, lines 10-21 to support her position. What that cited portion of the Dunster et al patent <u>actually</u> states is that: "The size of the internal diameter 90 of the tubes 80 as well as the length 94 of the tubes ++++ provide for <u>substantially uniform gas flows</u> through the tubes 80 from the chamber 68" (emphasis added). The cited section of the Dunster et al patent <u>also</u> states that: "Likewise the size of the orifices 86 is selected to provide +++ su<u>bstantially uniform volumes of gas flows</u> through the orifices 86 into the tubes 80." (emphasis added). This uniform gas flow through the tubes and the orifices results in a turbulent gas flow inside of the tubes, as noted above, and as repeatedly emphasized in Dunster et al.

None of the claims in the instant application relate to the provision of uniform volumes of gas flows or turbulent gas stream flows through either the transfer tubes. The Examiner has completely ignored this fact.

What all of the claims in the instant application relate to is the formation of an essentially homogeneous fuel/steam/ oxidant mixture which is suitable for use in an autothermal fuel gas reformer. This homogeneous mixture is created by a pressure differential which exists between the manifold and the interior of the transfer tubes. This pressure differential causes the gas stream which flows radially into the transfer tubes to deflect into the axial gas flow stream before the radially flowing stream penetrates the interior of the transfer tubes a distance which is about half of the radius of the interior of the transfer tubes. This result is not suggested by Dunster et al.

Dunster et al uses uniform volumes of gas flows through the transfer tubes and the radial openings and also gas flow rates in the transfer tubes in the transfer tubes to create a turbulent flowing gas stream in the transfer tubes. This turbulent flowing gas stream is also the result of the minimum gas velocity within the tubes (see Col. 5, first full paragraph of Dunster et al). This is the first result which is sought in Dunster et al. A second result sought in Dunster et al is the production of a uniform gas distribution over the inlet portion of the catalyst bed. This second result is accomplished by a particular configuration of the tube bores at the ends thereof which feed into the catalyst bed inlet. This second sought result of Dunster et al is described in the second full paragraph of Col. 5 of the patent. To accomplish this second result the tube bores are flared as shown by the numeral 84. These flares 84 will diffuse the turbulence and will result in a uniform gas distrubution over the inlet of the catalyst bed.

It is clear that the "variables" in Dunster et al relate, for the most part, to structural features of the tubes 80, those features, according to Dunster et al, being the size of the internal diameter 90 of the tubes 80, the length 94 of the tubes 80, the size of the orifices 86, the inclusion of the expanding passageways 84 and the angle 98 at which they diverge. These are the structural variables that effect the results desired, to put the analysis of Dunster et al reference in the "result effective variable" jargon used by the Examiner in this rejection. The other variable that Dunster et al refers to is the minimum velocity of gas flow through the tubes 80 that must be present to achieve the results desired by Dunster et al.

It is crystal clear in this case that mere pressure differential is not the variable which achieves the results desired by Dunster et al as alleged by the Examiner. There are actually six different variables in Dunster et al that are adjusted to achieve the desired result of "uniformity of gas flow". On page 5 in the last sentence of the first paragraph of the most

recent office action, the Examiner states that the desired result of a "result effective variable" would be "to get optimum operation". This standard of obviousness is ridiculous and demeaning. Everybody strives "to get optimum operation" of their inventions. The Examiner's reliance on the "result effective variable" doctrine set forth in In re Boesch and Slaney, 205 USPQ 215, CCPA, 1980) is ill advised in this case.

The reason for this is that the result sought in the instantly claimed invention is simply to have the radially flowing gas stream entrained and deflected into the axially flowing gas stream before the radially flowing gas stream penetrates the interior of the transfer tubes a distance which is about one'half the radius of the interior of the transfer tubes. This result is clearly set forth in all of the claims in this application. The variable for achieving this explicit result is the gas pressure differential between the manifold and the interior of the transfer tubes.

In Dunster et al, there are six variables put forth for achieving two different results. In the instant case there is one variable put forth for achieving one result. The six specific variables identified in Dunster et al are not the same as the variable identified in the instant application, and the two different results achieved in Dunster et al are not the same result achieved in the instant application.

SUMMARY

The rejections of all of the claims present in this application are based in whole or in part on Dunster et al, and all stand or fall with the veracity of the alleged "result effective variable" argument put forth by the Examiner. The Examiner has admitted that the specific limitations which are found in part g) of each of the independent claims in this application are not to be found explicitly or impliedly in any of the patents that she is relying on to formulate the rejection. This being the fact, the Examiner has ignored these limitations and dismissed them as being mere "result effective variables". As we have noted above, ignoring specific limitations in claims when rejecting those claims is improper. At any rate, the claimed result in the claims in question in this application is deflecting the radially flowing gas stream into the axially flowing gas stream before the radially flowing gas stream penetrates the transfer tubes a distance which is about one half of the radius of the interior of the transfer tubes. This result is nowhere to be found in Dunster et al or in any of the other three references that the Examiner is relying on. The result of entraining the radially flowing gas stream into the axially flowing gas stream is a combined turbulent gas flow stream. These results are clearly not the same. Dunster et al provides absolutely no motivation at all for seeking to produce the result claimed in the instant claims. There are six different variables described in Dunster et al, and five of them have something to do with the configuration of the transfer tubes. They are thus structural variables. The other variable is gas stream

minimum velocity. Thus, the results sought in the instant application is not the same result as is sought in Dunster et al, and the variable used in the instant application is not the same as any of the variables described in Dunster et al. Thus the "result effective variable" doctrine that the Examiner is relying on is in this case is not applicable to the claims in question here since the respective results are not the same and the respective variables are not the same. We have called the Examiner's attention to In re Antonie, 195 USPQ 6 (CCPA 1977) and we would call the Honorable Board's attention to that decision. In that case, the Court reversed a "result effective variable" rejection, noting that it is not obvious for one of ordinary skill in the art to try varying every parameter of a system in order to optimize the effectiveness of the system. The Court further noted that such an approach constitutes an obvious to try standard which is non statutory. This standard is what the Examiner has applied in the instant application in her rejections.

For the reasons advanced above, the Honorable Board is respectfully requested to reverse the rejections of Claims 3-17 in this case.

Respectfully submitted,

William W. Jones
Reg. No. 24,607
Attorney for Applicants
6 Juniper Lane
Madison, CT 06443
(203) 245-2418

Date: 1-23-04

(9) APPENDIX:

3. A method for mixing a fuel/steam gas with an oxidant gas to form an essentially homogeneous fuel/steam/oxidant mixture suitable for use in an autothermal fuel gas reformer catalyst bed, said method comprising the steps of:

a) providing an autothermal reformer catalyst bed having an inlet end;

b) providing an air/fuel/steam mixing station adjacent to said inlet end of said catalyst bed, said mixing station including an inlet chamber, a manifold interposed between said inlet chamber and said catalyst bed inlet end;

c) providing a plurality of cylindrical transfer tubes extending through said manifold from said inlet chamber to said inlet end of said catalyst bed each of said cylindrical transfer tubes having a plurality of gas entry passages in side walls of each of said transfer tubes, each of said gas passages having an axis which is perpendicular to an axis of said transfer tubes, each of said gas entry passages being spaced apart from said catalyst bed inlet end a distance which is at least two times the diameter of said cylindrical transfer tubes;

d) providing a first gas inlet passage opening into said inlet chamber;

e) providing a second gas inlet passage opening into said manifold;

f) Introducing a vaporized fuel/steam mixture into one of said inlet chamber or said manifold;

g) introducing an oxidant gas into the other of said inlet chamber or said manifold;

h) causing one of said fuel/steam mixture or said oxidant gas stream to flow axially through said transfer tubes toward said inlet end of said catalyst bed;

i) causing the other of said fuel/steam mixture or said oxidant to flow from said manifold radially into said transfer tubes through said gas entry passages; and

j) maintaining a pressure differential between the interior of said transfer tubes and said manifold which will result in the radially flowing stream entering said transfer tubes to be entrained and deflected into the axially flowing stream in the transfer tubes before the radially flowing stream penetrates the interior of the transfer tubes a distance which is about one-half of the radius of the interior of the transfer tubes.

4. The method of Claim 3 wherein said pressure differential between the gas stream in said transfer tubes and the gas stream in said manifold is only a few percentage points.

5. The method of Claim 3 wherein the fuel is gasoline.

6. The method of Claim 3 wherein the fuel is diesel fuel.

7. The method of Claim 3 wherein the fuel is methanol.

8. A method for mixing a fuel/steam gas with an oxidant gas to form an essentially homogeneous fuel/steam/oxidant mixture suitable for use in an autothermal fuel gas

reformer catalyst bed, said mixing method taking place in a fuel processing apparatus which includes an autothermal reformer catalyst bed having an inlet end, an oxidant/fuel/steam mixing station adjacent to said inlet end of said catalyst bed, said mixing station including an inlet chamber, a manifold interposed between said inlet chamber and said catalyst bed inlet end, and a plurality of cylindrical transfer tubes extending through said manifold from said inlet chamber to said inlet end of said catalyst bed each of said cylindrical transfer tubes having a plurality of gas entry passages in side walls of each of said transfer tubes, each of said gas passages having an axis which is perpendicular to an axis of said transfer tubes, each of said gas entry passages being spaced apart from said catalyst bed inlet end a distance which is at least two times the diameter of said cylindrical transfer tubes, said method comprising the steps of:

a) providing a first gas inlet passage opening into said inlet chamber;

b) providing a second gas inlet passage opening into said manifold;

c) Introducing a vaporized fuel/steam mixture into one of said inlet chamber or said manifold;

d) introducing an oxidant gas into the other of said inlet chamber or said manifold;

e) causing one of said fuel/steam mixture or said oxidant gas stream to flow axially through said transfer tubes toward said inlet end of said catalyst bed;

f) causing the other of said fuel/steam mixture or said oxidant to flow from said manifold radially into said transfer tubes through said gas entry passages; and

g) maintaining a pressure differential between the interior of said transfer tubes and said manifold which will result in the radially flowing stream entering said transfer tubes to be entrained and deflected into the axially flowing stream in the transfer tubes when the radially flowing stream penetrates the interior of the transfer tubes a distance which is about one-half the radius of the interior of the transfer tubes.

9. The method of Claim 8 wherein the fuel is gasoline.

10. The method of Claim 8 wherein the fuel is diesel fuel.

11. The method of Claim 8 wherein the fuel is methanol.

12. The method of Claim 8 wherein said fuel/steam mixture is passed axially through said transfer tubes and said oxidant enters said transfer tubes from said manifold.

13. A method for mixing an oxidant/steam gas with a vaporized fuel to form an essentially homogeneous fuel/steam/oxidant mixture suitable for use in an autothermal fuel gas reformer catalyst bed, said mixing method taking place in a fuel processing apparatus which includes an autothermal reformer catalyst bed having an inlet end, an oxidant/fuel/steam mixing station adjacent to said inlet end of said catalyst bed, said mixing station including an

inlet chamber, a manifold interposed between said inlet chamber and said catalyst bed inlet end, and a plurality of cylindrical transfer tubes extending through said manifold from said inlet chamber to said inlet end of said catalyst bed each of said cylindrical transfer tubes having a plurality of gas entry passages in side walls of each of said transfer tubes, each of said gas passages having an axis which is perpendicular to an axis of said transfer tubes, each of said gas entry passages being spaced apart from said catalyst bed inlet end a distance which is at least two times the diameter of said cylindrical transfer tubes, said method comprising the steps of:
a) providing a first gas inlet passage opening into said inlet chamber;
b) providing a second gas inlet passage opening into said manifold;
c) Introducing a vaporized fuel stream into one of said inlet chamber or said manifold;
d) introducing an oxidant/steam mixture into the other of said inlet chamber or said manifold;
e) causing one of said fuel stream or said oxidant/steam mixture to flow axially through said transfer tubes toward said inlet end of said catalyst bed;
f) causing the other of said vaporized fuel stream or said oxidant/steam mixture to flow from said manifold radially into said transfer tubes through said gas entry passages; and
g) maintaining a pressure differential between the interior of said transfer tubes and said manifold which will result in the radially flowing stream entering said transfer tubes to be entrained and deflected into the axially flowing stream in the transfer tubes when the radially flowing stream penetrates the interior of the transfer tubes a distance which is about one-half the radius of the interior of the transfer tubes.

14. The method of Claim 13 wherein the fuel is gasoline.

15. The method of Claim 13 wherein the fuel is diesel fuel.

16. The method of Claim 13 wherein the fuel is methanol.

17. The method of Claim 13 wherein said fuel stream is passed axially through said transfer tubes and said oxidant/steam mixture enters said transfer tubes from said manifold.

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This invention (Claims 3-17) relates to a method for mixing a fuel/steam gas with an oxidant gas to form an essentially homogeneous fuel/steam/oxidant mixture which is suitable for use in an autothermal fuel gas reformer. One of the gas streams flows axially through cylindrical transfer tubes toward an inlet end of a catalyst bed in the reformer. The transfer

tubes extend through a manifold and have radial openings which provide radial flow paths from the manifold to the interior of the transfer tubes. The openings are spaced apart from the inlet end of the catalyst bed a distance which is at least two times the diameter of the transfer tubes. The other of the gas streams flows into the transfer tubes through the radial openings. A pressure differential is maintained between the manifold and the interior of the transfer tubes which ensures that the gas stream flowing radially into the transfer tubes from the manifold will be deflected into the axially flowing gas stream when the radially flowing stream penetrates the interior of the transfer tubes a distance which is about one half of the radius of the interior of the transfer tubes. This deflection of the radially flowing gas stream is the result which is sought by the method of this invention.

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<u>A Brief Description Of The References</u>

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The Dunster et al reference discloses a gas mixer and distributor for a reactor which may be an autothermal reformer (see Col. 3, line 55). The mixer includes an inlet chamber 68 into which a gas stream P2 (66) flows at a pressure of 400 PSIA and a velocity of 100 ft/sec.. The inlet chamber 68 opens into a plurality of tubes 80. The tubes 80 each include a plurality of radial openings 86 (see FIG. 2) and open into a catalyst bed 32. The gas mixer also includes a manifold 72 into which another gas stream P1 flows at a pressure of 430 PSIA and a velocity of 110 ft./sec.. The intended result of the Dunster et al system is to create a turbulent gas flow stream in the tubes 80. We note that the terms "turbulent" or "turbulence" occurs six times in the Dunster et al specification; and again in each of the independent claims in Dunster et al. The manner in which the turbulent gas flow result is

achieved in Dunster et al is by varying the minimum gas flow velocity in the tubes 80 (see Col. 5, first full paragraph of Dunster et al). Dunster et al produces uniform gas distribution over the inlet to the catalyst bed by reducing the velocity of the gas flow into the catalyst bed by providing diverging passageways 84 at the bottom of the tubes 80 (see the second full paragraph in Col. 5 of the Dunster et al patent, and FIGS. 5 and 7 of the Dunster et al patent).

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<u>The Rejections</u>

<u>35 USC §103</u>

Claims 3, 4, 8, 12, 13 and 17 stand rejected as being obvious in view of Dunster et al. The Examiner in the most recent office action relies on the grounds for this rejection that were put forth in a previous office action dated June 23, 2003, which we will quote herein: "With respect to Claims 3, 8 and 13, Dunster et al discloses a method for mixing a fuel/steam or vaporized fuel with an oxidant gas or oxidant/steam gas +++ suitable for use in an autothermal fuel gas reformer catalyst bed +++ taking place in an apparatus comprising: a catalyst bed (32) having an inlet end (fig. 5); a mixing station (30) adjacent to said inlet end of the catalyst bed (fig. 5), said mixing station including an inlet chamber (68), a manifold (72) interposed between said inlet chamber (68) and said catalyst bed (32) inlet end +++; and a plurality of cylindrical transfer tubes (80) extending through said manifold (72) from said inlet chamber (68) to said inlet end of said catalyst bed +++ each of said tubes having a plurality of gas entry passages (86) in sides (sic, "side") walls of the tubes, each gas passage having an axis which is perpendicular +++ to an axis of the tubes, each passage spaced apart from the catlyst bed inlet end at a distance which is at least two times the diameter of said tubes (see fig. 2). The method comprising the steps of: providing a first gas inlet passage (66) opening into the inlet chamber (68); providing a second gas inlet passage (70) opening into said manifold (72); introducing a vaporized fuel/steam mixture)col. 3, lines 35-40) into said inlet chamber (68) or manifold (72); introducing an oxidant gas into the other of said inlet chamber (68) or said manifold (72); causing one of said fuel/steam mixture or said oxidant stream to flow axially through said transfer tubes toward the inlet of said catalyst bed and causing the other of said fuel/steam mixture or said oxidant stream to flow from said manifold (72) radially into said transfer tubes (80) through said gas entry passages (86) (col. 6, lines 9-13); maintaining a pressure differential between the interior of the transfer tubes and the manifold which will result in the radially flowing stream entering said

tubes to be entrained and deflected into the axially flowing stream (col. 5, lines 10-16).

Dunster et al does not disclose wherein the pressure differential is such that radially flowing stream penetrates the interior of the transfer tubes at a distance which is about one half of the radius of the interior of the transfer tubes, but Dunster et al does disclose wherein the pressure differential is a result-effectvie variable which effects (sic, 'affects'?) the uniformity of the gas flow (col. 5, lines 10-21). Since the pressure differential is a known result-effective variable, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify this variable to get optimum operation.

A result effective variable is a variable recognized in the art as a variable which, when modified, achieves a recognized result (MPEP 2144.05). A person having ordinary skill in the art would have found it obvious to determine the optimum value of any recognized result effective variable, as it has been held that if the difference between the claimed invention and the prior art involves the discovery of an optimum value of a result effective variable, such a discovery is ordinarily within the skill level of the art. In re Boesch and Slaney, +++ [205 USPQ 215] (CCPA 1980).

With respect to claim 4, Dunster et al does not disclose a percentage of pressure differential, Dunster et al does disclose wherein the pressure differential is a result-effective variable which effects (sic 'affects'?) the uniformity of gas flow (col. 5, lines 10-21). Since the pressure differential is a known result-effective variable, it would have been +++ to modify this variable to get optimum operation.

A result effective variable is a variable recognized in the art as a variable which, when modified, achieves a recognized result (MPEP 2144.05). A person having ordinary skill in the art would have found it obvious to determine the optimum value of any recognized result effective variable, as it has been held that if the difference between the claimed invention and the prior art involves the discovery of an optimum value of a result effective variable, such a discovery is ordinarily within the skill level of the art. In re Boesch and Slaney, +++ [205 USPQ 215] (CCPA 1980).

With respect to claims 12 and 17, Dunster et al discloses wherein said fuel or fuel/steam mixture passes axially through said transfer tubes and said oxidant or oxidant/steam mixture enters said transfer tubes (80) from said manifold (72) (col. 7, lines 6-17).".

The aforesaid is a quotation of the grounds for rejecting Claims 3, 4, 8, 12, 13 and 17 put forth on pages 2-5 in the office action dated June 23, 2003, and reiterated in the office action dated December 10, 2003.

Claims 5-7, 9-11 and 14-16 were rejected in the office action dated December 10, 2003. These claims were rejected as being obvious over the combination of Dunster et al and any one of Fourie et al, O'Connell et al or Lomax et al. Since the three secondary references are redundant references, the rejection based on only one combination of them will be quoted below. This

"Dunster et al discloses the general reforming of hydrocarbons but does not disclose specific hydrocarbons such as gasoline, diesel fuel and methanol.

Fourie et al discloses wherein gasoline, diesel fuel and methanol are typical reformable fuels (col. 1, lines 23-29). It would have been obvious +++ to select any hydrocarbon recognized for reforming processes in the method of Fourie et al as it is merely the selection of a specific hydrocarbon known to be effective in a reforming process.".

This same reasoning has been presented in support of the Dunster et al - O'Connell et al combination, and the Dunster et al - Lomax et al combination.

(8) THE ARGUMENT

As noted above, all of the rejections of the claims in this application are based on Dunster et al, and are grounded on a "result effective variable" argument that the Examiner thinks is supported by the portions of Dunster et al which she explicitly cites. The Examiner has admitted that the result sought by the claimed subject matter in the instant application, i.e., that the radially flowing stream will be deflected so as to flow axially in the mixing tubes after a mixing tube penetration which is about half the radius of the mixing tubes is not a "result" that is suggested as being desirable in Dunster et al.

The Examiner argues that Dunster et al discloses wherein the pressure differential between the manifold and the tubes is a result effective variable which affects the uniformity of the gas flow in the tubes. She cites Col. 5, lines 10-21 to support her position. What that cited portion of the Dunster et al patent actually states is that: "The size of the internal diameter 90 of the tubes 80 as well as the length 94 of the tubes ++++ provide for substantially uniform gas flows through the tubes 80 from the chamber 68" (emphasis added). The cited section of the Dunster et al patent also states that: "Likewise the size of the orifices 86 is selected to provide +++ substantially uniform volumes of gas flows through the orifices 86 into the tubes 80." (emphasis added). This uniform gas flow through the tubes and the orifices results in a turbulent gas flow inside of the tubes, as noted above, and as repeatedly emphasized in Dunster et al.

None of the claims in the instant application relate to the provision of uniform volumes of gas flows or turbulent gas stream flows through either the transfer tubes. The Examiner has completely ignored this fact.

What all of the claims in the instant application relate to is the formation of an essentially homogeneous fuel/steam/ oxidant mixture which is suitable for use in an autothermal fuel gas reformer. This homogeneous mixture is created by a pressure differential which exists between the manifold and the interior of the transfer tubes. This pressure differential causes the gas stream which flows radially into the transfer tubes to deflect into the axial gas flow stream before the radially flowing stream penetrates the interior of the transfer tubes a distance which is about half of the radius of the interior of the transfer tubes. This result is not suggested by Dunster et al.

Dunster et al uses uniform volumes of gas flows through the transfer tubes and the radial openings and also gas flow rates in the transfer tubes in the transfer tubes to create a turbulent flowing gas stream in the transfer tubes. This turbulent flowing gas stream is also the result of the minimum gas velocity within the tubes (see Col. 5, first full paragraph of Dunster et al). This is the first result which is sought in Dunster et al. A second result sought in Dunster et al is the production of a uniform gas distribution over the inlet portion of the catalyst bed. This second result is accomplished by a particular configuration of the tube bores at the ends thereof which feed into the catalyst bed inlet. This second sought result of Dunster et al is described in the second full paragraph of Col. 5 of the patent. To accomplish this second result the tube bores are flared as shown by the numeral 84. These flares 84 will diffuse the turbulence and will result in a uniform gas distrubution over the inlet of the catalyst bed.

It is clear that the "variables" in Dunster et al relate, for the most part, to structural features of the tubes 80, those features, according to Dunster et al, being the size of the internal diameter 90 of the tubes 80, the length 94 of the tubes 80, the size of the orifices 86, the inclusion of the expanding passageways 84 and the angle 98 at which they diverge. These are the structural variables that effect the results desired, to put the analysis of Dunster et al reference in the "result effective variable" jargon used by the Examiner in this rejection. The other variable that Dunster et al refers to is the minimum velocity of gas flow through the tubes 80 that must be present to achieve the results desired by Dunster et al.

It is crystal clear in this case that mere pressure differential is not the variable which achieves the results desired by Dunster et al as alleged by the Examiner. There are actually six different variables in Dunster et al that are adjusted to achieve the desired result of "uniformity of gas flow". On page 5 in the last sentence of the first paragraph of the most

recent office action, the Examiner states that the desired result of a "result effective variable" would be "to get optimum operation". This standard of obviousness is ridiculous and demeaning. Everybody strives "to get optimum operation" of their inventions. The Examiner's reliance on the "result effective variable" doctrine set forth in In re Boesch and Slaney, 205 USPQ 215, CCPA, 1980) is ill advised in this case.

The reason for this is that the result sought in the instantly claimed invention is simply to have the radially flowing gas stream entrained and deflected into the axially flowing gas stream before the radially flowing gas stream penetrates the interior of the transfer tubes a distance which is about one'half the radius of the interior of the transfer tubes. This result is clearly set forth in all of the claims in this application. The variable for achieving this explicit result is the gas pressure differential between the manifold and the interior of the transfer tubes.

In Dunster et al, there are six variables put forth for achieving two different results. In the instant case there is one variable put forth for achieving one result. The six specific variables identified in Dunster et al are not the same as the variable identified in the instant application, and the two different results achieved in Dunster et al are not the same result achieved in the instant application.

SUMMARY

The rejections of all of the claims present in this application are based in whole or in part on Dunster et al, and all stand or fall with the veracity of the alleged "result effective variable" argument put forth by the Examiner. The Examiner has admitted that the specific limitations which are found in part g) of each of the independent claims in this application are not to be found explicitly or impliedly in any of the patents that she is relying on to formulate the rejection. This being the fact, the Examiner has ignored these limitations and dismissed them as being mere "result effective variables". As we have noted above, ignoring specific limitations in claims when rejecting those claims is improper. At any rate, the claimed result in the claims in question in this application is deflecting the radially flowing gas stream into the axially flowing gas stream before the radially flowing gas stream penetrates the transfer tubes a distance which is about one half of the radius of the interior of the transfer tubes. This result is nowhere to be found in Dunster et al or in any of the other three references that the Examiner is relying on. The result of entraining the radially flowing gas stream into the axially flowing gas stream is a combined turbulent gas flow stream. These results are clearly not the same. Dunster et al provides absolutely no motivation at all for seeking to produce the result claimed in the instant claims. There are six different variables described in Dunster et al, and five of them have something to do with the configuration of the transfer tubes. They are thus structural variables. The other variable is gas stream

minimum velocity. Thus, the results sought in the instant application is not the same result as is sought in Dunster et al, and the variable used in the instant application is not the same as any of the variables described in Dunster et al. Thus the "result effective variable" doctrine that the Examiner is relying on is in this case is not applicable to the claims in question here since the respective results are not the same and the respective variables are not the same. We have called the Examiner's attention to In re Antonie, 195 USPQ 6 (CCPA 1977) and we would call the Honorable Board's attention to that decision. In that case, the Court reversed a "result effective variable" rejection, noting that it is not obvious for one of ordinary skill in the art to try varying every parameter of a system in order to optimize the effectiveness of the system. The Court further noted that such an approach constitutes an obvious to try standard which is non statutory. This standard is what the Examiner has applied in the instant application in her rejections.

For the reasons advanced above, the Honorable Board is respectfully requested to reverse the rejections of Claims 3-17 in this case.

Respectfully submitted,

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(9) APPENDIX:

3. A method for mixing a fuel/steam gas with an oxidant gas to form an essentially homogeneous fuel/steam/oxidant mixture suitable for use in an autothermal fuel gas reformer catalyst bed, said method comprising the steps of:
a) providing an autothermal reformer catalyst bed having an inlet end;
b) providing an air/fuel/steam mixing station adjacent to said inlet end of said catalyst bed, said mixing station including an inlet chamber, a manifold interposed between said inlet chamber and said catalyst bed inlet end;
c) providing a plurality of cylindrical transfer tubes extending through said manifold from said inlet chamber to said inlet end of said catalyst bed each of said cylindrical transfer tubes having a plurality of gas entry passages in side walls of each of said transfer tubes, each of said gas passages having an axis which is perpendicular to an axis of said transfer tubes, each of said gas entry passages being spaced apart from said catalyst bed inlet end a distance which is at least two times the diameter of said cylindrical transfer tubes;
d) providing a first gas inlet passage opening into said inlet chamber;
e) providing a second gas inlet passage opening into said manifold;
f) Introducing a vaporized fuel/steam mixture into one of said inlet chamber or said manifold;
g) introducing an oxidant gas into the other of said inlet chamber or said manifold;
h) causing one of said fuel/steam mixture or said oxidant gas stream to flow axially through said transfer tubes toward said inlet end of said catalyst bed;
i) causing the other of said fuel/steam mixture or said oxidant to flow from said manifold radially into said transfer tubes through said gas entry passages; and
j) maintaining a pressure differential between the interior of said transfer tubes and said manifold which will result in the radially flowing stream entering said transfer tubes to be entrained and deflected into the axially flowing stream in the transfer tubes before the radially flowing stream penetrates the interior of the transfer tubes a distance which is about one-half of the radius of the interior of the transfer tubes.

4. The method of Claim 3 wherein said pressure differential between the gas stream in said transfer tubes and the gas stream in said manifold is only a few percentage points.

5. The method of Claim 3 wherein the fuel is gasoline.

6. The method of Claim 3 wherein the fuel is diesel fuel.

7. The method of Claim 3 wherein the fuel is methanol.

8. A method for mixing a fuel/steam gas with an oxidant gas to form an essentially homogeneous fuel/steam/oxidant mixture suitable for use in an autothermal fuel gas

reformer catalyst bed, said mixing method taking place in a fuel processing apparatus which includes an autothermal reformer catalyst bed having an inlet end, an oxidant/fuel/steam mixing station adjacent to said inlet end of said catalyst bed, said mixing station including an inlet chamber, a manifold interposed between said inlet chamber and said catalyst bed inlet end, and a plurality of cylindrical transfer tubes extending through said manifold from said inlet chamber to said inlet end of said catalyst bed each of said cylindrical transfer tubes having a plurality of gas entry passages in side walls of each of said transfer tubes, each of said gas passages having an axis which is perpendicular to an axis of said transfer tubes, each of said gas entry passages being spaced apart from said catalyst bed inlet end a distance which is at least two times the diameter of said cylindrical transfer tubes, said method comprising the steps of:
a) providing a first gas inlet passage opening into said inlet chamber;
b) providing a second gas inlet passage opening into said manifold;
c) Introducing a vaporized fuel/steam mixture into one of said inlet chamber or said manifold;
d) introducing an oxidant gas into the other of said inlet chamber or said manifold;
e) causing one of said fuel/steam mixture or said oxidant gas stream to flow axially through said transfer tubes toward said inlet end of said catalyst bed;
f) causing the other of said fuel/steam mixture or said oxidant to flow from said manifold radially into said transfer tubes through said gas entry passages; and
g) maintaining a pressure differential between the interior of said transfer tubes and said manifold which will result in the radially flowing stream entering said transfer tubes to be entrained and deflected into the axially flowing stream in the transfer tubes when the radially flowing stream penetrates the interior of the transfer tubes a distance which is about one-half the radius of the interior of the transfer tubes.

9. The method of Claim 8 wherein the fuel is gasoline.

10. The method of Claim 8 wherein the fuel is diesel fuel.

11. The method of Claim 8 wherein the fuel is methanol.

12. The method of Claim 8 wherein said fuel/steam mixture is passed axially through said transfer tubes and said oxidant enters said transfer tubes from said manifold.

13. A method for mixing an oxidant/steam gas with a vaporized fuel to form an essentially homogeneous fuel/steam/oxidant mixture suitable for use in an autothermal fuel gas reformer catalyst bed, said mixing method taking place in a fuel processing apparatus which includes an autothermal reformer catalyst bed having an inlet end, an oxidant/fuel/steam mixing station adjacent to said inlet end of said catalyst bed, said mixing station including an

inlet chamber, a manifold interposed between said inlet chamber and said catalyst bed inlet end, and a plurality of cylindrical transfer tubes extending through said manifold from said inlet chamber to said inlet end of said catalyst bed each of said cylindrical transfer tubes having a plurality of gas entry passages in side walls of each of said transfer tubes, each of said gas passages having an axis which is perpendicular to an axis of said transfer tubes, each of said gas entry passages being spaced apart from said catalyst bed inlet end a distance which is at least two times the diameter of said cylindrical transfer tubes, said method comprising the steps of:

a) providing a first gas inlet passage opening into said inlet chamber;

b) providing a second gas inlet passage opening into said manifold;

c) Introducing a vaporized fuel stream into one of said inlet chamber or said manifold;

d) introducing an oxidant/steam mixture into the other of said inlet chamber or said manifold;

e) causing one of said fuel stream or said oxidant/steam mixture to flow axially through said transfer tubes toward said inlet end of said catalyst bed;

f) causing the other of said vaporized fuel stream or said oxidant/steam mixture to flow from said manifold radially into said transfer tubes through said gas entry passages; and

g) maintaining a pressure differential between the interior of said transfer tubes and said manifold which will result in the radially flowing stream entering said transfer tubes to be entrained and deflected into the axially flowing stream in the transfer tubes when the radially flowing stream penetrates the interior of the transfer tubes a distance which is about one-half the radius of the interior of the transfer tubes.

14. The method of Claim 13 wherein the fuel is gasoline.

15. The method of Claim 13 wherein the fuel is diesel fuel.

16. The method of Claim 13 wherein the fuel is methanol.

17. The method of Claim 13 wherein said fuel stream is passed axially through said transfer tubes and said oxidant/steam mixture enters said transfer tubes from said manifold.